

Northeast Consortium Annual Report

Project Title: **Flatfish Cage System for Bycatch Studies**

Periods of Performance: FY 2004 project development grant, October 2004-September 2005

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Project Objectives

1. Design small cages and a deployment system that can emulate conditions for flatfish discarded from fishing operations for later observation of survival or mortality.
2. As an initial application, use the cage system to evaluate tagging-induced mortality of yellowtail flounder.

Methods and Work Plan

Cage Design – We worked with Ketcham Trap (New Bedford, MA) to design and build three cages (see figure). They are cylindrical (6' diameter, 2' high), made of 1-inch coated wire mesh, with two 50' cement runners for stability. The design was based on the trap builders' experience, the capacity to move, deploy and retrieve cages on the F/V Ellen Diane, and our experiences holding yellowtail flounder in flow through systems in the Woods Hole aquarium. Cages were initially deployed in 24-26 fathoms with 210' of Everson 3/8" sinkline between the cage and a wash buoy. Scope of deployment was improved by lengthening the line to 230' because cage movement was observed after a storm. The buoy and a 13' single buoy highflyer and radar reflector were attached with whale-safe break-aways.

Trial Application – We used the system to evaluate mortality of tagged yellowtail flounder. At a meeting of tagging partners in January 2004, the need for a holding study was discussed as well as the potential for such holding systems to address broader bycatch problems (see cooperative-tagging.org for a summary of the meeting). Our experimental design involved collecting yellowtail in Ipswich Bay using tagging protocol (i.e., short tows with little bycatch of other species and immediate placement in flow-through tanks). We tagged 15 fish and place them in a cage floating at the surface by the boat. We also placed 15 untagged fish in the cage as controls. Tagged and control fish were selected using the quality control procedures in the tagging protocol to insure that viable fish are included in the study. Cages were lowered to the bottom. Oceanographic equipment (Hydrolab©) was deployed on a cage during deployment to monitor water quality during the experiment.

After three or four days, cages were hauled to the surface to observe survival of tagged and control fish. The ratio of survival of tagged and control fish was used to estimate tag-induced mortality. Survival of all tagged and control fish is an alternative estimate of mortality that includes that trawl-capture system.

Tissues were collected from five tagged fish and three control fish from each cage deployment to assess tag-induced stress. Preserved tissues will be analyzed by the University of Maryland Fish Pathology Lab for histological examination. Tissue analysis is funded by the Living Marine Resources Cooperative Research Center, associated with tank studies for yellowtail flounder.

Work Completed to Date

Each of the three cages was loaded with fish and deployed four times (totaling 12 deployments with 360 fish) from June 6 to 20, 2005:

Trip ID.	Cage #	Deployment	Retrieval	Days at Large
YT2005-01	1	9-Jun	13-Jun	4
YT2005-01	2	9-Jun	13-Jun	4
YT2005-01	3	9-Jun	13-Jun	4
YT2005-02	1	13-Jun	17-Jun	4
YT2005-02	2	13-Jun	17-Jun	4
YT2005-02	3	13-Jun	17-Jun	4
YT2005-03	1	17-Jun	20-Jun	3
YT2005-03	2	17-Jun	20-Jun	3
YT2005-03	3	17-Jun	20-Jun	3
YT2005-04	1	20-Jun	24-Jun	4
YT2005-04	2	20-Jun	24-Jun	4
YT2005-04	3	20-Jun	24-Jun	4

Cages were retrieved after three or four days. Fish were inspected for viability and condition and subsampled for tissue analysis. Data were keypunched and will be audited before statistical analyses are performed.

Results to Date

Development of Cage System

Transport, loading, deployment and retrieval of the cages was practical and efficient. The low mortality of fish indicated that the cage system held the fish in a viable habitat. However, during the second deployment, there were high winds, seas and tides and cages moved from their deployed position (up to 1.5 miles away for cage 3, in which six fish died – the most observed in the study). Therefore, more weight should be added to cages to reduce dragging. Furthermore position of deployment and retrieval should be carefully noted, and weather conditions should be monitored during deployments to help exclude data for quality control and analysis. Another aspect of cage-induced mortality appears to be predation by sand fleas. Most dead fish were observed in cage 3, where sand fleas were eating live fish.

Tagging-Induced Mortality

Results indicated low overall mortality of tagged and control fish. Of the 360 fish in the experiment, only 15 died, and more control fish died than tagged fish. Six fish died in the second deployment, which was associated with poor weather conditions and cage movement. Therefore, it appears that the trawl-capture and caging system impose more mortality than tagging. Preliminary analysis of unaudited data indicates no tag-induced mortality, because more control fish died than tagged fish, and approximately 3% mortality from the capture and cage system. Removal of data from cage-3, where sand-fleas were observed eating live fish, suggests a 1% mortality from the trawl-capture system.

Trip ID.	Cage	Deaths		Survival		Tagging	
		Control	Tagged	Control	Tagged	Both	Mortality
YT2005-01	1	1	0	93%	100%	97%	0%
YT2005-01	2	0	0	100%	100%	100%	0%
YT2005-01	3	2	0	87%	100%	93%	0%
YT2005-02	1	0	0	100%	100%	100%	0%
YT2005-02	2	0	0	100%	100%	100%	0%
YT2005-02	3	3	3	80%	80%	80%	0%
YT2005-03	1	0	0	100%	100%	100%	0%
YT2005-03	2	0	0	100%	100%	100%	0%
YT2005-03	3	0	1	100%	93%	97%	7%
YT2005-04	1	2	1	87%	93%	90%	0%
YT2005-04	2	0	0	100%	100%	100%	0%
YT2005-04	3	1	1	93%	93%	93%	0%
sum		9	6	95%	97%	96%	0%
excl. trial 2		6	3	96%	98%	97%	0%
excl. cage 3		3	1	98%	99%	99%	0%
excl. trial2-cage3		6	3	96%	98%	97%	0%

Data

Information from the cage study are being entered and audited in the existing yellowtail flounder tagging database. Data will be provided to the Consortium when auditing is complete, before the end of the grant period (October 2005).

Impacts and Applications

The cage study will have two applications:

1. Results from the trial application will be used in analysis of the larger yellowtail tagging study, and subsequent tagging-induced mortality experiments will be incorporated as standard tagging protocol.
2. In the longer-term, the cage system and the associated protocol can be modified to study bycatch mortality of flatfish by representing commercial fishing practices and conditions.

The results from this study and subsequent discard mortality studies will benefit researchers and managers, helping to improve the management of yellowtail and other flatfish resources. New information on yellowtail movement and independent estimates of mortality from the tagging study, and estimates of discard mortality should be useful for academic, state, and federal scientists and will be important information for fishery managers (i.e., the New England Fishery Management Council). The cooperative approach used in the experimental design is being continued throughout the analysis and interpretation stages of the study. Therefore, results and conclusions will be a product of all cooperators.

Co-principal investigators and other cooperators will meet annually to review results to date. Results will be posted on the website (cooperative-tagging.org) and presented to stock assessment workshops (e.g., SAW, TRAC), management meetings (e.g., groundfish committee) and industry groups (e.g., fishermen's forum, Fish Expo) in the form of technical reports and visual presentations. Estimates of mortality and movement from the tagging study will be prepared for the 2008 benchmark assessments of all yellowtail flounder stocks, for consideration in the determination of stock status.

Related Projects

This study was designed to complement the programmatic surveys and fishery sampling for yellowtail flounder stock assessments. It is coordinated with the Southern New England yellowtail tagging study conducted by the School for Marine Science and Technology, and the Yellowtail Industry Based Survey funded by NMFS Cooperative Research Partners Program. The tagging funded by the Northeast Consortium continues the initial yellowtail tagging funded by NMFS Stock Assessment Improvement Program in 2003. Tagging protocols, material and results are shared with Canada Department of Fisheries and Oceans to provide observations on eastern Georges Bank for the cooperative study. The holding studies are supported by a separate project development grant from the Northeast Consortium, and histological analyses are supported through a Living Marine Resources Cooperative Research Center grant.

Partnerships

The greatest resources available to the project are its personnel. Fishermen and researchers have cooperated to develop the general approach and technical details of the tagging study through several meetings from Rhode Island to Maine.

David Goethel and his crew are Gulf of Maine groundfish fishermen with experience in cod tagging and cooperative research. David has also helped in the experimental design and will continue to help with outreach in the Cape Cod-Gulf of Maine area.

Cooperating Research Agencies:

National Marine Fisheries Service
School for Marine Science and Technology
Massachusetts Division of Marine Fisheries
Rhode Island Department of Fish and Wildlife
Canada Department of Fisheries and Oceans
University of Maryland
Manomet Center

Presentations

Steve Cadrin presented “Movement of Yellowtail Flounder: A Cooperative Tagging Study” at the Ninth Flatfish Biology Conference (December 1 2004, Westbrook CT).

Steve Cadrin presented “Tagging Yellowtail Flounder with Commercial Fishermen” at the 61st Northeast Fish and Wildlife Conference (April 17-20 2005, Virginia Beach VA).

Larry Alade has two presentations accepted for the 2005 American Fisheries Society Annual Meeting (September 2005, Anchorage AK): “Application of a Mark and Recapture Model to Historical Data for Yellowtail Flounder off New England” and “A Pilot Study on Tag-induced Mortality of Yellowtail flounder (*Limanda ferruginea*)”

Student Participation

- Larry Alade is a doctoral student at the University of Maryland Eastern Shore working on developing the tagging model for yellowtail flounder as his doctoral research under the NOAA Educational Partnership Program.

- Henry Jackson was an undergraduate student at Jackson State University who provided technical support for the 2004 holding study as a NEFSC summer intern.
- Erica Anuzewski is an undergraduate student at the University of Maryland Eastern Shore working on the 2005 holding study as a LMRCRC intern.

Published Reports and Papers

Cadrin, S., A. Westwood, L. Alade, N. Keith, R. Rountree, D. Martins, R. Kessler, D. Jones, A. Valliere, J. King, J. Boardman, H. Stone and New England Fishermen. 2004. Movement of Yellowtail Flounder: A Cooperative Tagging Study. Pp 13 in Ninth Flatfish Biology Conference. NEFSC Ref. Doc. 04-13. (available online <http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0413>)

Tallack, S., Rago, P., T. Brawn, S. Cadrin, J. Hoey, and L. Taylor Singer. 2005. Proceedings of a workshop to review and evaluate the design and utility of fish mark - recapture projects in the northeastern United States. NEFSC Ref. Doc. 05-02. (available online <http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0502>)

Images (associated jpg files attached separately):

<u>Filename</u>	<u>Description</u>
cage.jpg	Photograph of a cage being loaded with yellowtail flounder prior to deployment.